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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/760,652
Filing Date: January 20, 2004
Appellant(s): TIERNEY ET AL.

Diana M. Sangali
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 8/23/10 appealing from the Office action mailed 3/22/10.

(1) Real Party in Interest

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

(2) Related Appeals and Interferences

The following are the related appeals, interferences, and judicial proceedings known to the examiner which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal:

10/760,640; 10/760,599; 10/760,659; 10/760,813; 10/761,073.

(3) Status of Claims

The following is a list of claims that are rejected and pending in the application:

1-34

(4) Status of Amendments After Final

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

(5) Summary of Claimed Subject Matter

The examiner has no comment on the summary of claimed subject matter contained in the brief.

(6) Grounds of Rejection to be Reviewed on Appeal

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being maintained by the examiner except for the grounds of rejection (if any) listed under the

subheading "WITHDRAWN REJECTIONS." New grounds of rejection (if any) are provided under the subheading "NEW GROUNDS OF REJECTION."

(7) Claims Appendix

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant's brief.

(8) Evidence Relied Upon

2004/0002992	Cypher	06-2003
6,922,756	Hum	12-2002
2004/0123047	Hum	12-2002
6,138,218	Arimilli	10-2000

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-6, 8-9, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cypher (2004/0002992) in view of Hum (6,922,756).

As per claim 1, Cypher discloses a system comprising: a first node operative to provide a source broadcast requesting data [Fig. 2A, ¶¶ 7, ll 1-7], the first node associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data responses from other nodes in the system [¶¶ 7, ll 7-13; ¶¶ 8, ll 9-14; ¶¶ 68, ll 4-22], the non-data responses including an indication that at least a second node includes a shared copy of the data [¶¶ 68; ll 1-11], the F-state enabling the first node to serve as an ordering point in the system [Fig. 1; ¶¶ 75-76].

As per claim 1, Cypher may not explicitly teach an F-state capable of responding to requests from the other nodes in the system with a shared copy of the data.

Hum discloses an F-state capable of responding to requests from the other nodes in the system with a shared copy of the data [col. 3, ll 6-11; col. 5, ll 66 to col. 6, ll 1] to permit a shared data to be transmitted from the current owning system component to the requesting system component without any concern of multiple data copies received at the requesting system component [col. 3, ll 7-9].

Thus, it would have been obvious to one of ordinary skill in the art at the time of invention by Applicant to modify the system of Cypher to include an F-state capable of responding to requests from the other nodes in the system with a shared copy of the data because this would have permitted a shared data to be transmitted from the current owning system component to the requesting system component without any concern of multiple data copies received at the requesting system component [col. 3, ll 7-9] as taught by Hum.

As per claim 2, Cypher discloses the non-data responses further comprise an indication that the other nodes in the system do not have a copy of the data requested by the first node [¶¶. 69].

As per claim 3, Cypher discloses the source broadcast requesting the data comprises a non-ownership request for the data [Fig. 4; ¶¶ 68; ll 1-9].

As per claim 4, Cypher discloses the non-ownership request comprises a source broadcast read request [¶¶. 7; ll 1-3, 10-16; ¶¶ 68].

As per claim 5, Cypher discloses the first node comprises a first processor having an associated cache that comprises plurality of cache lines, one of the cache lines having an address associated with the copy of data received from memory and state data that defines the state of the data stored in the one of the cache lines [Fig. 4].

As per claim 6, Cypher discloses the first processor further comprises a cache controller that controls the state of the data stored in the plurality of cache lines [Fig. 2A].

As per claim 8, Cypher discloses each node defines a processor having an associated cache that comprises a plurality of cache lines, each cache line having a

respective address that identifies associated data and state information that indicates a state of the associated data for the respective cache line, each of the processors being capable of communicating with each other via an interconnect [Fig. 2A].

As per claim 9, Cypher discloses a cache controller associated with each cache for managing data requests and responses for the respective cache [Fig. 2A; *Controllers 210A-210B*].

As per claim 13, Cypher discloses the ordering point defined by the F-state migrates from the first node to another node in response to the another node issuing a source broadcast non-ownership request for a copy of the data [pars. 75-76; Fig. 1].

Claims 7 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cypher (2004/0002992) in view of Hum (6,922,756) and further in view of Hum (2004/0123047).

As per claim 7, Hum discloses the cache controller is capable of evicting the data stored in the one of the cache lines by modifying the state information from the F-state to an invalid state for the data [Abstract; col. 5, ll 57-65].

However, Cypher and Hum may not explicitly teach silently evicting the data stored in the one of the cache lines.

Hum (2004/0123047) discloses silently evicting the data stored in the one of the cache lines [par. 65, ll 6-8] so the agent may not be aware that all copies have been evicted (par. 65, ll 7-10).

Thus, it would have been obvious to one of ordinary skill in the art at the time of invention by Applicant to modify the system of Cypher and Hum (756) to include silently evicting the data stored in the one of the cache lines because this would have enabled the agent to not be aware that all copies have been evicted (par. 65, ll 7-10) as taught by Hum (047).

As per claim 10, the rationale in the rejection 7 is herein incorporated.

Claims 11, 12, 14-15, 17-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cypher (2004/0002992) in view of Hum (6,922,756) and further in view of Arimilli (6,138,218).

As per claim 11, Cypher and Hum (756) disclose the claimed invention as discussed above in the previous paragraphs. However, Cypher and Hum (756) may not explicitly teach the system implements a source broadcast protocol to process requests and responses provided by nodes within the system, the system transferring to an associated forward progress protocol in response to a request failing in the source broadcast protocol.

Arimilli discloses the system implements a source broadcast protocol to process requests and responses provided by nodes within the system, the system transferring to an associated forward progress protocol in response to a request failing in the source broadcast protocol [col. 6, ll 39-45 and 54-64] to obviate the need for subsequent interventions (col. 6, ll 48-50).

Thus, it would have been obvious to one of ordinary skill in the art at the time of invention by Applicant to modify the system of Cypher and Hum (756) to include a source broadcast protocol to process requests and responses provided by nodes within the system, the system transferring to an associated forward progress protocol in response to a request failing in the source broadcast protocol because this would have helped obviated the need for subsequent interventions (col. 6, ll 48-50) as taught by Arimilli.

As per claim 12, Arimilli discloses the forward progress protocol comprises a directory-based protocol [col. 1, ll 35-40].

As per claim 14, the rationale in the rejection of claims 1 and 3 is herein incorporated.

However, Cypher and Hum (756) may not explicitly teach transitioning from the first state to a second state indicating that the data is shared; and the second node transitioning to a third state in response to receiving the shared copy of the data from

the first node, such that the second node becomes an ordering point in the network for providing a shared copy of the data.

Arimilli discloses transitioning from the first state to a second state indicating that the data is shared [col. 5, ll 60-67]; and the second node transitioning to a third state in response to receiving the shared copy of the data from the first node, such that the second node becomes an ordering point in the network for providing a shared copy of the data [col. 6, ll 1-15] to make forward progress towards an ultimate state on retried snoop operations (col. 1, ll 10-15).

Thus, it would have been obvious to one of ordinary skill in the art at the time of invention by Applicant to modify the system of Cypher and Hum (756) to include transition from the first state to a second state indicating that the data is shared because this would have made forward progress towards an ultimate state on retried snoop operations (col. 1, ll 10-15) as taught by Arimilli.

As per claim 15 the rationale in the rejection of claim 5 is herein incorporated.

As per claim 17 the rationale in the rejection of claim 11 is herein incorporated.

As per claim 18, Cypher discloses the forward progress protocol comprises a directory-based protocol [par. 7, ll 1-5].

As per claim 19, Arimilli discloses the third state and the second state are the same [col. 3, ll 17-25].

As per claim 20, the rationale in the rejection of claims 1 and 14 is herein incorporated.

As per claim 21, Cypher discloses at least one other processor having an associated cache that does not include a valid copy of the desired data, the at least one other processor responding to the broadcast request with a response indicating that the at least one other processor does not include a valid copy of the desired data [¶¶. 69].

As per claim 23, the rationale in the rejection of claim 3 is herein incorporated.

As per claim 24, the rationale in the rejection of claim 4 is herein incorporated.

As per claim 25, the rationale in the rejection of claim 11 is herein incorporated.

As per claim 26, the rationale in the rejection of claim 20 is herein incorporated.

As per claim 27, Cypher discloses the means for enabling defines an ordering point in the system for responding to non-ownership requests for the data, the system further comprising means for migrating the ordering point from the first node to another

node in the system in response to a non-ownership request for the data provided by the another node [pars. 75-76].

As per claim 28, the rationale in the rejection of claim 11 is herein incorporated.

As per claim 29, Cypher discloses the memory comprises a home node for the requested data, the system further comprising means for blocking the home node from responding with data to another request if the first node provides a response to the another request that includes a shared copy of the data [Fig. 4; ¶¶ 68; ll 1-9].

As per claim 30, the rationale in the rejection of claim 26 is herein incorporated.

As per claim 31, Hum discloses silently evicting the data from the source node by modifying the state of the data in the source node to an invalid state [col. 5, ll 57-67].

As per claim 32, Cypher discloses moving the ordering point for the data from the source node to another node in response to a non-ownership request for the data provided by the another node [pars. 75-76].

As per claim 33, the rationale in the rejection of claim 5 is herein incorporated.

As per claim 34, the rationale in the rejection of claim 11 is herein incorporated.

Claims 16 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cypher (2004/0002992) in view of Hum (6,922,756), Arimilli (6,138,218), and further in view of Hum (2004/0123047).

As per claim 16, the rationale in the rejection of claim 10 is herein incorporated.

However, Cypher, Hum, and Arimilli may not explicitly teach silently evicting the data by modifying the state information for the cache line to an invalid state.

Hum (2004/0123047) discloses silently evicting the data stored in the one of the cache lines by modifying the state information for the cache line to an invalid state [par. 65, ll 6-8] so the agent may not be aware that all copies have been evicted (par. 65, ll 7-10).

Thus, it would have been obvious to one of ordinary skill in the art at the time of invention by Applicant to modify the system of Cypher, Hum (756), and Arimilli to include silently evicting the data stored in the one of the cache lines because this would have enabled the agent to not be aware that all copies have been evicted (par. 65, ll 7-10) as taught by Hum (047).

As per claim 22, the rationale in the rejection of claim 16 is herein incorporated.

However, Cypher, Hum, and Arimilli may not explicitly teach silently evicting the data by returning to the first state.

Hum (2004/0123047) discloses silently evicting the data stored in the one of the cache lines by returning to the first state [par. 65, ll 6-8] so the agent may not be aware that all copies have been evicted (par. 65, ll 7-10).

Thus, it would have been obvious to one of ordinary skill in the art at the time of invention by Applicant to modify the system of Cypher and Hum (756) to include silently evicting the data stored in the one of the cache lines because this would have enabled the agent not be aware that all copies have been evicted (par. 65, ll 7-10) as taught by Hum (047).

Allowable Subject Matter

Claim 35 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

(10) Response to Argument

The present invention relates to a system and method for creating ordering points in a multiprocessor network that includes a plurality of processor nodes in communication with each other. At least a first node of the plurality of processor nodes includes a copy of data associated with a given address that is also shared with memory. The first node operates in a first state that causes the first node to respond to a non-ownership request from a second node of the plurality of processor nodes for the

data by (i) sending a response to the second node that includes a shared copy of the data and (ii) transitioning from the first state to a second state indicating that the data is shared. The second node transitions to a third state in response to receiving the shared copy of the data from the first node, such that the second node becomes an ordering point in the network for providing a shared copy of the data [See specification, page 3, lines 3-13].

The computer system includes a plurality of processors comprising a source processor that issues broadcast request for desired data while in a first state and at least one target processor having an associated cache that includes a shared copy of the desired data. The at least one target processor responds to the broadcast request with a response indicating that the at least one second processor includes the shared copy of the desired data. Memory stores the desired data, the memory responding to the broadcast request with a response that includes a copy of the desired data. The source processor transitions from the first state to a second state in response to receiving the responses form the memory and the at least one target processor. The second state enables the first processor to respond to requests from other of the plurality of processors with a copy of the desired data [page 3, lines 14-25].

The invention also comprises a method that includes broadcasting a read request for data from a source node to other nodes of an associated state. The source node transitions o an F-state in response to receiving data from memory and receiving non-data responses from other target nodes in the system indicating that the data is shared with at least one of the other target nodes. The method also includes enabling

the source node, while in the F-state, to serve as an ordering point that is capable of responding to non-ownership requests for the data by providing a shared copy of the data [page 3, lines 26-33].

An ordering point defines a serialization of requests to the same memory line (or memory block) that is understood and followed by the system (e.g., an ordering point can respond to requests) [page 4, line 30 to page 5, line 1]. A state of the data block cached at a processor node defines the processor node as a point for serializing requests from other processor nodes for the data block. Thus, when a source processor node issues a request for a data block, a target processor node that is a cache ordering point for the data can provide a data response. It is the state of the cached data that defines the node (processor) as a cache ordering point for the data. When a processor responds with D-DATA, the ordering point is transferred to the requesting processor. S-DATA is a shared data response that indicates data is being returned from a cache ordering point, although the ordering point itself is not being transferred to the requester.

Examiner would like to also make it clear that though the prior art must disclose the claimed invention in as complete detail as is contained in the claims, this is not however an ipsissimis verbis test, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990). Though the prior art may use terms similar to that of applicants' claimed invention, it also suffices that the prior art discloses the claimed subject matter at least in the manner recited in applicants' specification.

Appellant's arguments on pages 11-12, that Cypher and Hum fail to teach or suggest an F-state when describing systems employing directory based protocols" are clearly erroneous.

From page 6, TABLE 1, and paragraph [0034] of applicants' specification, the claimed F-state is simply described as "First among equals; the cache line is valid and unmodified by caching processor. Other processors may have valid copies, and caching processor may respond to snoops by returning data. The F-state corresponds to a shared cache line that can respond to requests for data with a response that includes a shared copy of the requested data".

Likewise, Cypher discloses "when a subsystem having a shared copy of data observes a coherence request for exclusive access to the block, its copy is typically invalidated; when a subsystem that currently owns a block of data observes a coherence request to that block, the owning subsystem typically responds by providing the data to the requestor and invalidating its copy; par. 0007; a directory containing shared copies of data and in response to coherency request for exclusive access to sharing subsystems; par. 0008; home agent 102 in the receiving home client detects the shared state for one or more other clients; since the slave agents 104 are each in the shared state, not the owned state, the home client 102 may supply the requested data directly to the requesting client; par. 0068".

Hum also discloses "an F-state permitting a shared data to be transmitted from the current owning system component to the requester; col. 3, ll 5-10; a First among equals; Col. 5, ll 57-67", as described in TABLE 1 of applicants' specification.

Thus, the prior art of record clearly discloses "a system that includes a node that can associate an F-state with a copy of data".

Appellant's arguments on pages 11-12 that Cypher fails to teach or suggest "a first node operative to provide a source broadcast requesting data, the first node associating an F-state with a copy of the data in response to receiving responses" recited in claim 1 are clearly erroneous.

Cypher discloses multiprocessing systems employing broadcast protocol where coherence requests are broadcast and if the system that currently owns a block (i.e., source) of data observes a coherency request, the owning system responds by providing the data to the requestor; par. 0007.

Furthermore, as explained above, the combination of Cypher and Hum (6,922,756) clearly discloses "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system". Cypher further discloses "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the shared state for one or more other clients; since the slave agents are each in the

shared state, the home client may supply the requested data directly to the requesting client; home agent transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

Appellant further contends on pages 11-12, that in claim 1, "the first node (that associates the F-state) is also operative to provide a source broadcast request for data", whereas Cypher explicitly discloses a directory based point-to-point response to detection of a cache miss.

In the previous paragraphs, it was made clear that Cypher discloses "a first node operative to provide a source broadcast requesting data, the first node associating an F-state with a copy of the data in response to receiving responses; See pars. 0007 and 0068". Examiner would like to further point out that the functional recitations of "the first node (that associates the F-state) is also [capable of or] operative to provide a source broadcast request for data" do not make the claimed invention patentably distinct over the prior art of record. While features of a system may be recited either structurally or functionally, claims directed to a system must be distinguished from the prior art in terms of structure rather than function. *In re Schreiber*, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429, 1431-32 (Fed. Cir. 1997) (The absence of a disclosure in a prior

art reference relating to function did not defeat the Board's finding of anticipation of claimed apparatus because the limitations at issue were found to be inherent in the prior art reference); see also *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 228-29 (CCPA 1971); *In re Danly,* 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959). "System claims cover what a device *is*, not what a device *does*." *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1469, 15 USPQ2d 1525, 1528 (Fed. Cir. 1990) (emphasis in original).

Appellant's arguments on page 12, that neither Hum (756) nor Cypher teach or suggest "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system, the non-data responses including an indication that at least a second node includes as shared copy of the data", recited in claim 1 are clearly erroneous.

As explained above, the combination of Cypher and Hum (756) clearly discloses "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system". Cypher further discloses "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the shared state for one or more other clients; since the slave agents are each in the shared state, the home client may supply the requested data directly to the requesting client; home agent

transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

Appellant's arguments on page 12, that "the F-state disclosed in Hum is not associated with a copy of the data in response to receiving the copy of the data from memory and receiving non-data responses from other nodes in the system", recited in claim 1 are clearly erroneous.

From page 6, TABLE 1, and paragraph [0034] of applicants' specification, the claimed F-state is simply described as "First among equals; the cache line is valid and unmodified by caching processor. Other processors may have valid copies, and caching processor may respond to snoops by returning data. The F-state corresponds to a shared cache line that can respond to requests for data with a response that includes a shared copy of the requested data".

Hum unequivocally discloses "a cache line in the F-state is used to respond to request for a copy of the cache line, the newly created copy is placed in the F state and the cache line previously in the F state is put in the shared (S) state; the F state permits a shared data to be transmitted from the current owning system component to the requesting system component without concern of multiple data copies received at the requesting system component (i.e., shared);

the F state can be described as a "first among equals" notion in the context where there exists a valid copy of requested data in memory; Abstract; col. 3, lines 6-11; col. 5, lines 66 to col. 6, line 1".

Appellant's arguments on page 12, of the Brief that "the Final Office Action has not shown a valid reason why one skilled in the art would have been led to combine Cypher with Hum in a manner that would result in the claimed invention" are clearly in error..

First of all, Examiner would like to remind applicants that there are three possible sources for a motivation to combine references: the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art." *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58 (Fed. Cir. 1998). Furthermore, obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so >. *In re Kahn*, 441 F.3d 977, 986, 78 USPQ2d 1329, 1335 (Fed. Cir. 2006). Above all, the teaching, suggestion, or motivation must be found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. In our case, the motivation to combining the references was found in the references themselves as shown in the rejection section of the claims above.

Appellant's arguments on page 13, "no reason exists for modifying Cypher with the teachings of Hum in a manner that would result in the invention recited in claim 1" are clearly erroneous.

In determining obviousness under 35 U.S.C 103 in view of the Supreme Court decision in KSR International Co. v. Teleflex Inc., the Supreme Court stated that the Federal Circuit had erred in four ways: (1) "By holding that courts and patent examiners should look only to the problem the patentee was trying to solve;" (2) by assuming "that a person of ordinary skill attempting to solve a problem will be led only to those elements of prior art designed to solve the same problem;" (3) by concluding "that a patent claim cannot be proved obvious merely by showing that the combination of elements was obvious to try;" and (4) by overemphasizing "the risk of courts and patent examiners falling prey to hindsight bias" and as a result applying "[r]igid preventative rules that deny fact finders recourse to common sense."

Furthermore, the Supreme Court stated that: "When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill".

Still further, the court states that "the focus when making a determination of obviousness should be on what a person of ordinary skill in the pertinent art would have known at the time of the invention…and this is regardless of whether the source of that knowledge and ability was documentary prior art, general knowledge in the art, or common sense".

Finally, for purposes of 35 U.S.C 103, prior art can be either in the field of applicant's endeavor or be reasonably pertinent to the particular problem with which the applicant was concerned. Furthermore, prior art that is in a field of endeavor other than that of the applicant, or solves a problem which is different from that which the applicant was trying to solve, may also be considered for the purposes of 35 U.S.C 103. See, e.g., In re *KSR International Co. v. Teleflex Inc.,* 550 U.S. at_,82 USPQ2d at 1396 (2007).

Appellant's arguments on page 13, that the system of Cypher fails to teach or suggest "a system including non-data responses" of claim 2 are clearly erroneous.

Claim 2 simply recites "non-data responses comprising an indication that the other nodes in the system do not have a copy of the data requested by the first node" and similarly Cypher unequivocally discloses "in response to a coherency request, invalidation transactions (i.e., non-data responses) may be conveyed (i.e., broadcast) to the sharing subsystems (i.e., an indication that the other nodes in the system do not have a copy of the data requested by the first node); par. 0008; and home agent sends

invalidate coherency demands (i.e., non-data responses) to all other slave agents; par. 0069".

Appellant's arguments on page 13, that the system of Cypher "has no need for receiving responses that indicate that the other nodes in the system do not have a copy of the requested data" are clearly in error.

It appears that appellant has failed to consider, in its entirety, and have misconstrued the teaching of Cypher because throughout the entire disclosure, Cypher repeatedly mentions that his invention deals with both broadcast and point to point transactions. Additionally, Cypher explained "home agent updates its directory to indicate that the requesting client is the owner and that each of the other clients is invalid; the invalidate demand causes the receiving slave to invalidate the corresponding coherency unit; [par. 0068]". Cypher further discloses that "the conveyance of the invalidation coherency demands may be considered a multicast, (hence broadcast); par. 0068".

Appellant's arguments on pages 13-14 , regarding claim 3, that "paragraph [0068] of Cypher refers to system which uses point-to-point transactions, not broadcast transactions and that paragraph [0068] lines 1-9 of Cypher discloses a point-to-point (not broadcast) "read to own" requests that is transmitted to the home client 102".

Examiner respectfully disagrees and would like to mention that applicants failed to consider, in its entirety, and have misconstrued the teaching of Cypher because throughout the entire disclosure, Cypher repeatedly makes it clear that his invention deals with both broadcast and point to point transactions. Additionally, Cypher explained "home agent updates its directory to indicate that the requesting client is the owner and that each of the other clients is invalid; the invalidate demand causes the receiving slave to invalidate the corresponding coherency unit; [par. 0068]". Cypher further disclose that "**the conveyance of the invalidation coherency demands may be considered a multicast, (hence broadcast)**; par. 0068".

Appellant's arguments on page 14, regarding claim 4, that Cypher fails to teach or suggest "the non-ownership broadcast read requests" and "a non-ownership request comprising a source broadcast read request" are clearly in error.

Cypher discloses "in response to a coherency request, invalidation transactions may be conveyed to the sharing subsystems; par. 0008; and home agent sends invalidate coherency demands (i.e., non-ownership requests) to all other slave agents; par. 0069; home agent updates its directory to indicate that the requesting client is the owner and that each of the other clients is invalid; the invalidate demand causes the receiving

slave to invalidate the corresponding coherency unit; [par. 0068]". Cypher further disclose that "the conveyance of the invalidation coherency demands may be considered a multicast, (hence broadcast); par. 0068".

Appellant's arguments on pages 14-15, regarding claim 13 that Cypher is silent on "associating an F-state with a node in the manner recited in claim 1 to enable the node to operate in the manner recited, let alone the migration of the ordering point defined by the F-state" are clearly in error.

Claim 13 simply recites "the ordering point defined by the F-state migrates from the first node to another node in response to the another node issuing a source broadcast non-ownership request for a copy of the data". The F-state was addressed above with respect to claim 1 and Cypher discloses how "a home agent marks a requestor as the sole owner of the line and sends an RTO (read-to-own) demand to the owning slave agent; home agent also sends invalidate coherency demands to all other slave agents with a shared copy; the owning slave agent reply with data to the requesting agent and invalidates its copy; paragraph [0069]; wherein various ordering points are established within a node which govern ownership and access right transitions such as the broadcast ordering point in which a client may serve as an ordering point transitioning from one node to another (i.e., migrating or moving the ordering point); pars. [0075-0076]". The home agent sending invalidate coherency demand to all other slave

agents with a shared copy, the sending of read-to-own (RTO) demand to the slave agent, and the home agent marking a requestor as the sole owner migrates the ordering point from a slave node to a home node in response to the home node sending/broadcasting the read-to-own (RTO) request.

Appellant's arguments on page 15, with respect to claim 7 that Hum 2 fails to teach or suggest "a silent eviction could be implemented by a cache controller for data stored in cache lines by modifying state information from an F-state to an invalid" are clearly in error.

Claim 7 simply recites "the cache controller is capable of silently evicting the data stored in the one of the cache lines by modifying the state information from the F-state to an invalid state for the data".

From page 6, TABLE 1, and paragraph [0034] of applicants' specification, the claimed F-state is simply described as "First among equals; the cache line is valid and unmodified by caching processor. Other processors may have valid copies, and caching processor may respond to snoops by returning data. The F-state corresponds to a shared cache line that can respond to requests for data with a response that includes a shared copy of the requested data. The F-state can be silently evicted (i.e., transitioning to the I-state with no copy being written to memory)".

Hum 2 identically discloses "a cache line in the F-state is used to respond to request for a copy of the cache; the newly created copy is placed in the F-state and the cache line previously in the F-state is put in the in the Invalid (I) state; Abstract; the F-state is used in a system where requests are broadcast which means that the responses cannot be observed by all nodes in the system (hence silently evicting the data stored in the cache line) and the node having data stored in the F-state cannot have a unique copy because a valid copy is stored in memory; the F-state can be described as a "first among equals"; col. 5, ll 57-67".

Appellant's arguments on page 16, with respect to claim 10 that Cypher taken in view of Hum and in further view of Hum 2 fails to teach or suggest that "a cache controller comprises a state engine capable of silently evicting data stored in a cache line having an F-state by modifying the state information for the cache line from the F-state to an invalid state for the data" are clearly in error.

Hum identically discloses "a cache line in the F-state is used to respond to request for a copy of the cache; the newly created copy is placed in the F-state and the cache line previously in the F-state is put in the Invalid (I) state; Abstract; the F-state is used in a system where requests are broadcast which means that the responses cannot be observed by all nodes in the system (hence silently evicting the data stored in the cache line) and the node having data stored in the

F-state cannot have a unique copy because a valid copy is stored in memory; the F-state can be described as a "first among equals"; col. 5, ll 57-67; and the cache memory controller causes the copy of the requested data to be stored in the cache memory and designated in the forward state; Fig. 6; col. 12, lines 10-16".

Appellant's arguments on page 17, regarding claim 11 that "changing a cache state (as disclosed in Arimilli) does not correspond to transferring from a source broadcast protocol to a forward progress protocol in response to a request failing in the source broadcast protocol" are clearly erroneous.

Arimillli discloses at least in the manner described on page 2, paragraphs [0006-0007] and page 10, paragraph [0041] of applicants' specification, "a mechanism for making forward progress on retried snoop hilts involves undertaking an action, in response to detecting an operation on the system bus which was subject of a previous failed intervention, which moves the coherency state of a requested cache item toward the expected coherency state at the completion of the original operation; col. 6, ll 39-45; wherein upon an intervention being stopped by a retry, L2 sets a flag indicating that the requested cache item has been the subject of a failed intervention; upon detecting the same operation again through its snoop logic (snooping is a well known broadcast cache coherency

protocol) and detecting the operation being retried (i.e., operation has failed) again, L2 cache initiates the action intended to achieve forward progress; col. 6, lines 54-64".

Appellant's arguments on page 17 that Cypher taken in view of Hum and in further view of Arimilli fails to teach or suggest that "a second node becomes an ordering point in a network in response to receiving a shared copy of the data" recited in claim 14 are clearly in error.

The limitation of "a second node becoming an ordering point in a network in response to receiving a shared copy of the data" was addressed above with respect to claim. As shown above, Cypher discloses how "various ordering points are established within a node which govern ownership and access right transitions such as the broadcast ordering point in which a client may serve as an ordering point transitioning from one node to another; pars. [0075-0076]". The home agent sending invalidate coherency demand to all other slave agents with a shared copy, the sending of read-to-own (RTO) demand to the slave agent, and the home agent marking a requestor as the sole owner migrates the ordering point from a slave node to a home node in response to the home node sending/broadcasting the read-to-own (RTO) request.

Arimilli also discloses "transitioning requested cache item to a shared or invalid coherency state and making forward progress on retried snoop hits in

response to detecting an operation on the system bus which was the subject of a previous failed intervention and moving the coherency state of a requested cache item toward the expected coherency state; col. 6, lines 1-15; 39-46".

Appellant's arguments on page 18 that Arimilli simply contains no disclosure or suggestion to "states that might correspond to the first, second and third states" recited in claim 19 are clearly erroneous.

Arimilli discloses "requested cache item being in a coherency state other that the modified state, and altering the coherency state to a shared or invalid state; col. 3, lines 17-34; col. 6, lines 1-10; "action including altering the coherency state to a shared or invalid state; transition of the coherency state progress along a sequence terminating in the shared state; or transition progress along a sequence ending in the invalid state; col. 3, ll 17-25".

Hum also discloses "multiple system components simultaneously request the same data and multiple other system components have the data in shared state; col. 2, lines 5-8".

Appellant's arguments on page 18 that claim 20 recites that "a source processor transitions form the first state to a second state in response to

receiving responses from the memory and the at least one target processor" and that "no such state transition is taught in Cypher, Hum, or Arimilli" are erroneous.

Cypher discloses "a processing subsystem receiving coherency demands for a memory block which is modified in cache, changing state information for that block and changing state information to indicate the memory block is no longer valid; par. [0062]".

Hum also discloses "after request for ownership is granted, the state of the data is changed from shared to another state (e.g., modified); col. 2, lines 14-16; a peer node transitioning its copy of the cache line to a shared state; col. 6, lines 47-55; col. 7, lines 11-17".

Arimilli also discloses transitioning from the first state to a second state indicating that the data is shared [col. 5, ll 60-67]; and the second node transitioning to a third state in response to receiving the shared copy of the data from the first node, such that the second node becomes an ordering point in the network for providing a shared copy of the data [col. 6, ll 1-15].

Appellant's arguments on pages 19-20 that Cypher taken in view of Hum and Arimilli does not make claim 21 obvious are clearly erroneous.

Claim 21 simply recites "at least one other processor having an associated cache that does not include a valid copy of the desired data, the at least one other processor responding to the broadcast request with a response

indicating that the at least one other processor does not include a valid copy of the desired data". Likewise, Cypher unequivocally describes how "a home agent marks a requestor as the sole owner of the line and sends an RTO demand to the owning slave agent; home agent also sends invalidate coherency demands to all other slave agents with a shared copy; the owning slave agent reply with data to the requesting agent and invalidates its copy; paragraph [0069]".

Appellant's arguments on page 20 with respect to claim 23 that Cypher discloses point-to-point not broadcast transactions are clearly in error.

Cypher discloses multiprocessing systems employing broadcast protocol where coherence requests are broadcast and if the system that currently owns a block (i.e., source) of data observes a coherency request, the owning system responds by providing the data to the requestor; par. 0007.

Furthermore, as explained above, the combination of Cypher and Hum (6,922,756) clearly discloses "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system". Cypher further discloses "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the shared state for one or more other clients; since the slave agents are each in the

shared state, the home client may supply the requested data directly to the requesting client; home agent transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

Appellant's arguments on pages 20-21 that "the point-to-point read to own transactions disclosed in Cypher fails to teach or suggest the non-ownership source broadcast read requests" recited in claim 24 are clearly in error.

Cypher discloses multiprocessing systems employing broadcast protocol where coherence requests are broadcast and if the system that currently owns a block (i.e., source) of data observes a coherency request, the owning system responds by providing the data to the requestor; par. 0007.

Furthermore, as explained above, the combination of Cypher and Hum (6,922,756) clearly discloses "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system". Cypher further discloses "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the shared state for one or more other clients; since the slave agents are each in the shared state, the home client may supply the requested data directly to the

requesting client; home agent transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

Appellant's arguments on page 21 that Cypher taken in view of Hum and in further view of Arimilli fails to teach or suggest "a system that implements a source broadcast protocol that defines rules for processing broadcast requests provided by processors within the system and, if a requests fails, the system transfers to an associated forward progress directory-based protocol" recited in claim 25 are clearly erroneous.

Cypher discloses multiprocessing systems employing broadcast protocol where coherence requests are broadcast and if the system that currently owns a block (i.e., source) of data observes a coherency request, the owning system responds by providing the data to the requestor; par. 0007.

Furthermore, as explained above, the combination of Cypher and Hum (6,922,756) clearly discloses "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system". Cypher further discloses "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the

shared state for one or more other clients; since the slave agents are each in the shared state, the home client may supply the requested data directly to the requesting client; home agent transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

Arimillli also discloses at least in the manner described on page 2, paragraphs [0006-0007] and page 10, paragraph [0041] of applicants' specification, "a mechanism for making forward progress on retried snoop hilts involves undertaking an action, in response to detecting an operation on the system bus which was subject of a previous failed intervention, which moves the coherency state of a requested cache item toward the expected coherency state at the completion of the original operation; col. 6, ll 39-45; wherein upon an intervention being stopped by a retry, L2 sets a flag indicating that the requested cache item has been the subject of a failed intervention; upon detecting the same operation again through its snoop logic (snooping is a well known broadcast cache coherency protocol) and detecting the operation being retried (i.e., operation has failed) again, L2 cache initiates the action intended to achieve forward progress; col. 6, lines 54-64".

Appellant's arguments on page 22 that Cypher does not teach "means for broadcasting from a first node a non-ownership request for data" recited in claim 26 are clearly in error.

Cypher discloses multiprocessing systems employing broadcast protocol where coherence requests are broadcast and if the system that currently owns a block (i.e., source) of data observes a coherency request, the owning system responds by providing the data to the requestor; par. 0007.

Furthermore, as explained above, the combination of Cypher and Hum (6,922,756) clearly discloses "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system". Cypher further discloses "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the shared state for one or more other clients; since the slave agents are each in the shared state, the home client may supply the requested data directly to the requesting client; home agent transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

Appellant's arguments on page 22, with respect to claim 26 that Hum and Arimilli fail to teach or suggest "means for enabling a first node to respond to subsequent non-ownership requests for data from other nodes in the system by providing a shared copy of data received from memory" are clearly in error.

Cypher discloses "in response to a coherency request, invalidation transactions may be conveyed to the sharing subsystems; par. 0008; and home agent sends invalidate coherency demands (i.e., non-ownership requests) to all other slave agents; par. 0069; home agent updates its directory to indicate that the requesting client is the owner and that each of the other clients is invalid; the invalidate demand causes the receiving slave to invalidate the corresponding coherency unit; [par. 0068]". Cypher further disclose that "the conveyance of the invalidation coherency demands may be considered a multicast, (hence broadcast); par. 0068; "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the shared state for one or more other clients; since the slave agents are each in the shared state, the home client may supply the requested data directly to the requesting client; home agent transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

Cypher discloses how "a home agent marks a requestor as the sole owner of the line and sends an RTO (read-to-own) demand to the owning slave agent; home agent also sends invalidate coherency demands to all other slave agents with a shared copy; the owning slave agent reply with data to the requesting agent and invalidates its copy; paragraph [0069]; wherein various ordering points are established within a node which govern ownership and access right transitions such as the broadcast ordering point in which a client may serve as an ordering point transitioning from one node to another; pars. [0075-0076]". The home agent sending invalidate coherency demand to all other slave agents with a shared copy, the sending of read-to-own (RTO) demand to the slave agent, and the home agent marking a requestor as the sole owner migrates the ordering point from a slave node to a home node in response to the home node sending/broadcasting.

Appellant's arguments on page 28 that Arimilli fails to teach or suggest that "the system employs source broadcast protocol in combination with the means for transferring to an associated forward progress directory-based protocol for processing a request if the request fails in a source broadcast protocol" recited in claim 28 are clearly erroneous.

These limitations and arguments are fully addressed in the paragraphs supra.

Appellant's arguments on page 23-24 that Cypher fails to teach or suggest "a home node for the requested data, and means for blocking the home node from responding with the data to another request" recited in claim 29 are erroneous.

Cypher clearly discloses "coherency activity in response to a read-to-own request when a slave agent is the current owner (i.e., home node) of the coherency unit and other slave agents have shared copies of the coherency unit; the request agent initiates the transaction by sending a read-to-own request to home agent; this causes home agent to block new transactions to this coherency unit; home agent marks the requestor as the sole owner of the line and sends invalidate coherency demands to all other slave agents with a shared copy; paragraph [0069]". Cypher also teaches the means for broadcasting as shown above and with respect to claim 26.

Appellant's arguments on page 24 that Cypher refers to a point-to-point transaction and not broadcasting a read request for data from a source node to other nodes of an associated, recited in claim 30 are in error.

Cypher discloses multiprocessing systems employing broadcast protocol where coherence requests are broadcast and if the system that currently owns a

block (i.e., source) of data observes a coherency request, the owning system responds by providing the data to the requestor; par. 0007.

Furthermore, as explained above, the combination of Cypher and Hum (6,922,756) clearly discloses "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system". Cypher further discloses "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the shared state for one or more other clients; since the slave agents are each in the shared state, the home client may supply the requested data directly to the requesting client; home agent transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

It appears that appellant has failed to consider, in its entirety, and have misconstrued the teaching of Cypher because throughout the entire disclosure, Cypher repeatedly mentions that his invention deals with both broadcast and point to point transactions. Additionally, Cypher explained "home agent updates its directory to indicate that the requesting client is the owner and that each of the other clients is invalid; the invalidate demand causes the receiving slave to invalidate the corresponding coherency unit; [par. 0068]". Cypher further

discloses that "the conveyance of the invalidation coherency demands may be considered a multicast, (hence broadcast); par. 0068".

Appellant's arguments on page 25, that Hum fails to teach or suggest "enabling a source node, while in an F-state, to serve as an ordering point that is capable of responding to non-ownership requests for data by providing a shared copy of the data" recited in claim 30 are erroneous.

The combination of Cypher, Hum and Arimilli is relied upon in rejecting claim 30. The combination of Cypher and Hum (6,922,756) clearly discloses "associating an F-state with a copy of the data in response to receiving the copy of the data from memory and receiving non-data response from other nodes in the system". Cypher further discloses "the non-data responses including an indication that at least a second node includes as shared copy of the data" in at least par. [0068] where "a home agent detects the shared state for one or more other clients; since the slave agents are each in the shared state, the home client may supply the requested data directly to the requesting client; home agent transmitting invalidate coherency demands to each of the slave agents which are maintaining shared copies of the affected coherency unit; the invalidate coherency demand causes the receiving slave agent to invalidate the corresponding coherency unit within the slave".

Appellant's arguments on page 25, that neither Cypher nor Hum provide support to "enable one of ordinary skill in the art to provide for the transition to the F-state" and that Arimilli fails to teach or suggest "enabling a source node, while in an F-state, to serve as an ordering point that is capable of responding to non-ownership requests for data by providing a shared copy of the data" recited in claim 30 are clearly in error.

As the combination of Cypher, Hum and Arimilli is relied upon in rejecting claim 30, Cypher and Hum teach the claimed F-state as shown above while Arimilli discloses "transitioning requested cache item to a shared or invalid coherency state and making forward progress on retried snoop hits in response to detecting an operation on the system bus which was the subject of a previous failed intervention and moving the coherency state of a requested cache item toward the expected coherency state; col. 6, lines 1-15; 39-46".

Appellant's arguments on pages 25-26 that none of the prior art teaches or suggests that "moving ordering point for data from source node to another node in response to a non-ownership request for data provided by another node" recited in claim 32 are in error.

Cypher discloses how "a home agent marks a requestor as the sole owner of the line and sends an RTO (read-to-own) demand to the owning slave agent;

home agent also sends invalidate coherency demands to all other slave agents with a shared copy; the owning slave agent reply with data to the requesting agent and invalidates its copy; paragraph [0069]; wherein various ordering points are established within a node which govern ownership and access right transitions such as the broadcast ordering point in which a client may serve as an ordering point transitioning from one node to another (i.e., migrating or moving the ordering point); pars. [0075-0076]". The home agent sending invalidate coherency demand to all other slave agents with a shared copy, the sending of read-to-own (RTO) demand to the slave agent, and the home agent marking a requestor as the sole owner migrates the ordering point from a slave node to a home node in response to the home node sending/broadcasting the read-to-own (RTO) request.

Appellant's arguments on page 26 that Arimilli fails to teach or suggest "reissuing a read request employing an associated forward progress if a read request broadcast by a source node fails while employing a source broadcast protocol" are in error.

Arimillli discloses at least in the manner described on page 2, paragraphs [0006-0007] and page 10, paragraph [0041] of applicants' specification, "a mechanism for making forward progress on retried snoop hilts involves undertaking an action, in response to detecting an operation

on the system bus which was subject of a previous failed intervention, which moves the coherency state of a requested cache item toward the expected coherency state at the completion of the original operation; col. 6, ll 39-45; wherein upon an intervention being stopped by a retry, L2 sets a flag indicating that the requested cache item has been the subject of a failed intervention; upon detecting the same operation again through its snoop logic (snooping is a well known broadcast cache coherency protocol) and detecting the operation being retried (i.e., operation has failed) again, L2 cache initiates the action intended to achieve forward progress; col. 6, lines 54-64".

Appellant's arguments on pages 26-27 that Cypher in view of Hum and further view of Arimilli and Hum 2 fails to teach or suggest "a cache line in one of a first and second states being capable of silently evicting associated data by modifying state information for the cache line to an invalid state" recited in claim 16 or that "a source processor, after transitioning to a second state is capable of silently evicting desired data by returning to a first state" recited in claim 22 are erroneous.

Claim 16 simply recites "a cache line in one of the first and second states being capable of silently evicting associated data by modifying the state information for the cache line to an invalid state" and claim 22 simply recites

"wherein the processor, after transitioning to the second state, is capable of silently evicting the desired data by returning to the first".

Hum 2 identically discloses "a cache line in the F-state is used to respond to request for a copy of the cache; the newly created copy is placed in the F-state and the cache line previously in the F-state is put in the in the Invalid (I) state; Abstract; the F-state is used in a system where requests are broadcast which means that the responses cannot be observed by all nodes in the system (hence silently evicting the data stored in the cache line) and the node having data stored in the F-state cannot have a unique copy because a valid copy is stored in memory; the F-state can be described as a "first among equals"; col. 5, ll 57-67".

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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